

Standards, rationales, and proposed benchmarks**Content standard 1: Number sense and operations:**

- **A student, applying reasoning and problem solving, will use number sense and operations to represent numbers in multiple ways, understand relationships among numbers and number systems, make reasonable estimates and compute fluently within a variety of relevant cultural contexts.**

Rationale: Number sense and computational fluency are the foundation for school mathematics and life in a quantitative society within multiple cultures including those of Montana American Indians. Students who have a sense of quantity; are fluent with basic facts; perform mental computations; determine the reasonableness of a solution; and understand properties of operations have the power to solve problems and use number to describe the world. The foundation of number sense and operations supports the other content standards.

Benchmarks:

At the end of 4th grade, a proficient student will:

Benchmark 1.1	Place Value: Demonstrate the relationship among whole numbers, identify place value up to 100,000, and compare numbers (i.e., greater than, less than, equal).
Benchmark 1.2	Estimation: Estimate and calculate sums, differences, and products when solving problems including cultural situations when relevant.
Benchmark 1.3	Whole Number Operations: Develop multiplication and division concepts and strategies, demonstrate fluency with basic facts, and compute up to three- by two-digit whole number multiplication problems.
Benchmark 1.4	Fractions/Decimals: Identify and model common fractions (i.e., tenths, quarters, halves) and decimals (e.g., money and place value to 0.001) and recognize and compare equivalent representations.
Benchmark 1.5	Measurement: Select and apply appropriate standard units and tools to measure weight, time, and temperature.

At the end of 8th grade, a proficient student will:

Benchmark 1.1	Number Theory: Apply number theory concepts (e.g. primes, factors, and multiples) in mathematical problem situations.
Benchmark 1.2	Estimation: Select and apply appropriate estimation strategies to measure, compute, and judge results in terms of reasonableness and accuracy. (E.g., estimate an irrational number using the square roots of perfect square numbers.
Benchmark 1.3	Rational Numbers: Recognize relationships among different representations of rational numbers and identify, compare and order rational numbers as well as common irrational numbers.
Benchmark 1.4	Rational Number Operations: Compute fluently and solve multi-step problems using integers, fractions, decimals, percents, and numbers in exponential form.
Benchmark 1.5	Proportional Reasoning: Understand and apply proportional relationships and solve problems involving rates, ratios, proportions and percents.
Benchmark 1.6	Measurement: Demonstrate an understanding of measurable attributes of objects, and the units, systems, and processes of measurement within relevant cultural contexts.

Upon graduation a proficient student will:

Benchmark 1.1	(Magnitude): Represent very large and very small numbers using multiple notations and interpret their effects in problem situations.
Benchmark 1.2	Estimation: Identify situations where estimation is appropriate and determine the needed degree of accuracy for a given problem situation.
Benchmark 1.3	Equivalence: Given a representation of a number or expression, find equivalent representations using multiple notations (e.g., exponents and roots).
Benchmark 1.4	Properties: Analyze and apply the properties of numbers and number systems.
Benchmark 1.5	Modeling: Identify givens and unknowns in an unfamiliar situation and describe relationships between variables (e.g., the effect of changing an interest rate on monthly payments).

Content Standard 2: Data Analysis:

- A student, applying reasoning and problem solving, will use data representation and analysis, probability, statistics and statistical methods to evaluate information and make informed decisions within a variety of relevant cultural contexts.

Rationale: Data analysis or statistical literacy pertains to all aspects of daily life within multiple cultures including those of Montana American Indians. As consumers of information, students who analyze data to make decisions and predictions are prepared to be responsible citizens. Students who understand and apply basic concepts of probability and make connections to data analysis build strong quantitative reasoning for productive personal and professional lives.

Benchmarks:

At the end of 4th grade, a proficient student will:

Benchmark 2.1	Represent Data: Represent and organize data in tables, line plots, bar graphs, pictographs, and stem and leaf plots.
Benchmark 2.2	Evaluate Data: Use data to solve problems (e.g. ordering or finding maximum, minimum, median when applicable).
Benchmark 2.3	Probability: Describe events as likely or unlikely and discuss the degree of likelihood using words such as certain, equally likely, and impossible including cultural context when relevant.

At the end of 8th grade, a proficient will:

Benchmark 2.1	Represent Data: Collect, organize and represent data (e.g. box plots, histograms, scatter plots, circle graphs) in culturally relevant contexts.
Benchmark 2.2	Evaluate Data: Interpret, analyze, and evaluate data to make decisions and predictions (e.g. trends in data).
Benchmark 2.3	Descriptive Statistics: Compute and apply mean, median, mode, and range to compare and describe data.
Benchmark 2.4	Probability: Using real-life contexts or simulation create sample spaces, determine experimental and theoretical probabilities (e.g. using tree diagrams) and make predictions.

Upon graduation, a proficient student will:

Benchmark 2.1	Represent Data: Using technology when appropriate, select and create graphical or numerical representations for data set and compare different data sets using measures of central tendency and spread (e.g., percentiles, quartiles, inter-quartile range, and standard deviation).
Benchmark 2.2	Evaluate Data: Evaluate reports based on data collected and/or published by considering the source of the data, the design of the study, and the way data are analyzed and displayed (e.g. correlation does not prove causation).
Benchmark 2.3	Regression: Given two variable data, decide on an appropriate model, determine a regression equation using technology and decide when predictions based on such regression equations are valid.
Benchmark 2.4	Probability: Use basic rules to compute probabilities and use probability to evaluate problem situations.
Benchmark 2.5	Counting: Determine the number of outcomes for an event or compound events using permutations, combinations, and other counting methods.

Content Standard 3: Geometric Reasoning:

- **A student, applying reasoning and problem solving, will understand geometric properties and spatial relationships, transformation of shapes, representational systems, spatial reasoning and geometric models to analyze mathematical situations within a variety of relevant cultural contexts.**
- **Rationale: Geometric reasoning compliments the study of number and operation. Students who have a sense of space; analyze two- and three-dimensional shapes, their properties and relationships can make connections within mathematics. Geometric reasoning can help students appreciate and value mathematics and make connections to their world throughout multiple cultures including those of Montana American Indians.**

Benchmarks:

At the end of 4th grade, a proficient student will:

Benchmark 3.1	2-D Attributes: Describe, compare, and analyze attributes of two-dimensional shapes.
Benchmark 3.2	Area & Perimeter: Define and determine area and perimeter of common polygons.
Benchmark 3.3	3-D Attributes: Identify attributes of three-dimensional shapes (e.g., cubes, rectangular prisms, pyramids, cylinders, cones, spheres).
Benchmark 3.4	Lines: Recognize, draw, and represent intersecting, parallel, and perpendicular sets of lines.
Benchmark 3.5	Measurement: Measure linear objects in metric units (e.g., centimeters and meters) and standard units (e.g., half inch, inch, foot, and yard).

At the end of 8th grade, a proficient student will:

Benchmark 3.1	Properties: Define, classify and compare properties of solids and plane figures, including angles.
Benchmark 3.2	Relationships: Determine congruence, similarity, and symmetry of objects in mathematics and in the contexts of art, science and culture.
Benchmark 3.3	Transformations: Define, identify, and apply transformations (e.g. translations, rotations, reflections, dilations) on the coordinate plane.
Benchmark 3.4	Measurement: Select appropriate metric or standard units and formulas to measure and compute angles, perimeter, area, surface area, and volume.
Benchmark 3.5	Justification: Develop informal arguments to verify geometric relationships (e.g. Pythagorean Theorem) and solve problems.

Upon graduation, a proficient student will:

Benchmark 3.1	Reasoning: Use inductive and deductive reasoning to verify conjectures about relationships (e.g., congruence) between two- and three- dimensional objects.
Benchmark 3.2	Transformations: Apply transformations on figures (e.g. dilations, rotations, translations, reflections) to solve problems, and interpret the results of composite transformations.
Benchmark 3.3	Triangle Relationships: Solve problems using triangles, including special triangles (e.g., 30-60-90) and properties of triangles (e.g. sine, cosine, tangent).
Benchmark 3.4	Methods of proof: Make, test, and validate conjectures using a variety of techniques (e.g., counterexample, indirect proof).
Benchmark 3.5	Applications: Use spatial reasoning and geometric models to solve real world problems involving regular and irregular shapes.

Content Standard 4: Algebraic and Functional Reasoning:

- A student, applying reasoning and problem solving, will use algebraic and functional concepts and procedures to understand patterns, quantitative and functional relationships, algebraic representations, models and change within a variety of relevant cultural contexts.

Rationale: The study of algebra and functions opens doors and expands opportunities in numerous 21st century careers throughout many cultures including those of Montana American Indians. Students who generalize patterns and represent relationships in multiple ways develop significant understandings of mathematics and the use of quantitative reasoning in other disciplines. Algebra and functions are powerful tools for making informed decisions on a daily basis.

Benchmarks:

At the end of 4th grade, a proficient student will:

Benchmark 4.1	Patterns: Describe, extend, and make generalizations about patterns.
Benchmark 4.2	Properties: Use number patterns to investigate properties of numbers (e.g., even or odd) and operations (e.g., multiplicative/additive identities, commutative, associative, distributive).
Benchmark 4.3	Symbols: Use letters, boxes, or symbols to represent numbers in simple expressions or equations (i.e., demonstrate an understanding and use of variable).
Benchmark 4.4	Equivalence: Develop an understanding of equivalence by expressing numbers, measures, or numerical expressions in a variety of ways.
Benchmark 4.5	Modeling: Model problem situations with objects and use representations such as words, pictures, tables, or graphs to draw conclusions including in cultural contexts when relevant.

At the end of 8th grade, a proficient student will:

Benchmark 4.1	Patterns: Create and use tables, graphs, words, and symbols/variables to represent, analyze, and generalize a variety of patterns.
Benchmark 4.2	Equivalence: Recognize, simplify, and generate equivalent forms for algebraic expressions.
Benchmark 4.3	Solving: Use number properties and inverse operations to solve single-variable equations and inequalities.
Benchmark 4.4	Function: Identify linear and non-linear functional relationships and contrast their properties from tables, graphs, or equations.
Benchmark 4.5	Modeling: Identify and compute rate of change/slope and intercepts from equations, graphs, and tables; model and solve contextual problems involving linear proportions.

Upon graduation, a proficient student will:

Benchmark 4.1	Symbols: Choose appropriate variables to construct expressions and equations representing given problem situations (e.g., linear, quadratic, exponential).
Benchmark 4.2	Solving: Solve a variety of equations, inequalities and their systems; justify the solution process using properties of numbers; and interpret solutions in context.
Benchmark 4.3	Functions: Represent functions in a variety of ways including tabular, graphic, symbolic, and verbal, and select an appropriate form for solving a given problem.
Benchmark 4.4	Transforming Functions: Analyze the effects of transformations on families of functions, recognize their characteristics, and represent functions in equivalent forms.
Benchmark 4.5	Modeling: Given data or a problem situation, select and use an appropriate function model to analyze results or make a prediction.
Benchmark 4.6	Connections with Geometry: Represent geometric problems algebraically and algebraic situations geometrically.